HDMI-DVI-Component Video
Compilation of Various Sources

What are DVI, HDMI and Component Video?

DVI/HDMI and Component Video are all video standards which support a variety of resolutions, but which deliver the signal from the source to the display in very different ways. The principal important difference is that DVI/HDMI deliver the signal in a digital format, much the same way that a file is delivered from one computer to another along a network, while Component Video is an analog format, delivering the signal not as a bitstream, but as a set of continuously varying voltages representing (albeit indirectly, as we'll get to in a moment) the red, green and blue components of the signal.

Both DVI/HDMI and Component Video deliver signals as discrete red, green, and blue color components, together with sync information which allows the display to determine when a new line, or a new frame, begins. The DVI/HDMI standard delivers these along three data channels in a format called T.M.D.S., which stands for "Transmission Minimized Differential Signaling." Big words aside, the T.M.D.S. format basically involves a blue channel to which horizontal and vertical sync are added, and separate green and red channels.

Component Video is delivered, similarly, with the color information split up three ways. However, component video uses a "color-difference" type signal, which consists of Luminance (the "Y", or "green," channel, representing the total brightness of the image), Red Minus Luminance (the "Pr," or "Red," channel), and Blue Minus Luminance (the "Pb," or "Blue," channel). The sync pulses for both horizontal and vertical are delivered on the Y channel. The display calculates the values of red, green and blue from the Y, Pb, and Pr signals.

Both signal types, then, are fundamentally quite similar; they break up the image in similar ways, and deliver the same type of information to the display, albeit in different forms. How they differ, as we'll see, will depend to a great extent upon the particular characteristics of the source and display devices, and can depend upon cabling as well.

There are several HDMI vs DVI questions that are causing much confusion. What is the difference? Which one is better? Are DVI and HDMI compatible? And of course, given the choice, which one should you use? We provide all the details below. The differences (or lack thereof) may surprise you.
Confused about connection types?

DVI is the abbreviation of Digital Visual Interface, while HDMI stands for High Definition Multimedia Interface. DVI and HDMI are more similar than different. There are a very few differences between them. DVI is an interface, which is used for providing high quality image. In DVI, the pixels are transmitted as binary data, and the brightness is set accordingly. Since the quality provided by HDMI is good, many people opt HDMI over S Video, SCART, D Terminal and many more. The signals for HDMI and DVI are compatible with each other, hence no signal conversion is required when using a DVI adapter for HDMI, and vice versa; also there is no loss of data when a DVI adapter is used for HDMI or vice versa. HDMI is said to be a successor of DVI, hence HDMI is better than DVI in many aspects, like the transfer rate of HDMI is more than DVI. Both DVI and HDMI transfer signals, use separate red, green and blue components and the components are transferred through different data channels. HDMI is derived from the protocol used by DVI, hence the working and encoding scheme for both the technologies are same.

HDMI vs DVI What is the Difference?

When looking at the differences, HDMI vs DVI actually have more in common then differences. They are both all digital, they also are all based on similar specifications since HDMI was derived from the DVI specification. There are two big differences: HDMI incorporates content protection called High Definition Content Protection (HDCP). HDMI supports audio in addition to digital video. (DVI only supports digital video).

As DVI and HDMI connections become more and more widely used, we are often asked: which is better, DVI (or HDMI) or component video? The answer, as it happens, is not cut-and-dried.

First, to clear away one element that can be confusing: DVI and HDMI are exactly the same as one another, image-quality-wise. The principal differences are that HDMI carries audio as well as video, and uses a different type of connector, but both use the same encoding scheme, and that's why a DVI source can be connected to an HDMI monitor, or vice versa, with a DVI/HDMI cable, with no intervening converter box.

The upshot of this article--in case you're not inclined to read all the details--is that it's very hard to predict whether a digital DVI or HDMI connection will produce a better or worse image than an analog component video connection. There will often be significant differences between the digital and the analog signals, but those differences are not inherent in the connection type and instead depend upon the characteristics of the source device (e.g., your DVD player) and the display device (e.g., your TV set). Why that is, however, requires a bit more discussion.

The difference between DVI and HDMI are as follows:

Digital Visual Interface (DVI)

- DVI was developed by Digital Display Working Group (DDWG).
- It transmits digital video signals. Depending on the version, it transmits video signals in digital or analog format.
- The equipments where DVI is widely used are flat panel LCD computer and digital projectors.
- There are three versions of DVI; DVI-A, DVI-D and DVI-I. DVI-A transmits video in an analog format. DVI-D transmits video in digital format. DVI-I or integrated mode can transmit video signals in both analog and digital formats.
- DVI is like a computer connection with a large connector and a series of pins at one end.
- No provisions are made for the security of the content.
- As compared to HDMI, DVI is more affected by noise.

High Definition Multimedia Interface (HDMI)

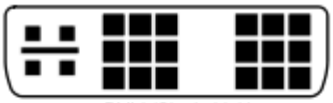
- HDMI was invented by Hitachi, Philips, Sony, Toshiba, Thomson, Panasonic and Quasar.
- It transmits audio as well as video signals in digital format.
- HDMI is used in set top boxes, personal computers, video games, blue ray disc players and digital TVs.
- The versions of HDMI are; HDMI 1.0, HDMI 1.1, HDMI 1.2 and HDMI 1.3. HDMI 1.0 does not transmit DVD audio, but HDMI 1.1 supports the transmission of DVD audio. HDMI 1.2 acts as an interface to computers. HDMI 1.3 backs color support. It is the only cable provided with PS3. Hence HDMI 1.3 requires larger bandwidth.

- HDMI cable is like a USB cable, that slides into the slot of the source device.
- Provisions are made for the security of the content. A digital copy called HDCP is used for providing security.
- HDMI reduces the amount of noise.

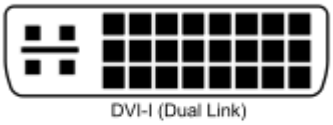
Both HDMI and DVI provide good quality output, and hence they are preferred over other cords. But the quality of output provided by HDMI is better than DVI; also HDMI has many advantages over DVI. HDMI has captured almost 100% of the market.

What is DVI

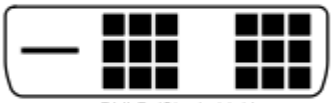
We will start the HDMI vs DVI comparison with an introduction to the Digital Visual Interface (DVI). Reason being that it was developed first and HDMI is based off of DVI. DVI is a digital standard introduced in 1999 by the Digital Display Working Group (DDWG).


DVI-I (Single Link)

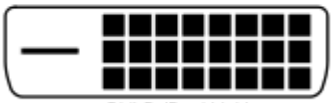
It is designed primarily for carrying uncompressed digital video data to a display. Originally the display was a computer monitor but DVI is now commonly used for television as well. If you're interested in technical information then you can download the DVI specification from here.


DVI-I (Dual Link)

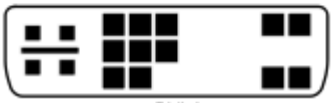
One of the main areas of confusion with DVI is the number of different connectors available, which represent different functionality. There are three main connection types for DVI.


DVI-D (Single Link)

DVI-D (digital only)
DVI-A (analog only)
DVI-I (digital & analog)


DVI-D (Dual Link)

In addition the digital connections also add to the confusion by adding Dual Link creating an additional connection. Dual Link simple adds additional pins for a second set of data signals.


DVI-A

When buying adapters or attempting to connect various components examine your connections closely to determine which ones you have. Beware, the cheap component to DVI converters are typically DVI-A (analog) which is really just a connection adapter while the DVI to HDMI are DVI-D (or DVI-I) which is a cable adapter for the digital connections.

What is HDMI

The High-Definition Multimedia Interface (HDMI), released late in 2002, is an all-digital audio/video interface capable of transmitting uncompressed streams similar to DVI. However HDMI also incorporates HDCP, which is a Digital Rights Management technology. HDMI provides an interface between any compatible digital audio/video source, such as a set-top box, a DVD player, a PC, a video game system, or an AV receiver and a compatible digital audio and/or video monitor, such as a digital television (DTV).

Although HDMI has a standard connector, like DVI, HDMI also has its way of confusing and frustrating users. Although the connector for HDMI remains the same, the versions change. Meaning that it is possible that components that can be plugged in together, using the HDMI connecter, will not necessarily work together. Therefore the consumer is stuck with noting the various versions (Latest

version is 1.3) of HDMI available and trying to make sure they will work together. Each device is manufactured to adhere to various versions of the specification, where each version is given a number, such as 1.0 or 1.3. Each concurrent version of the specification uses the same cables, but increases the throughput and capabilities of what can be transmitted over the cable. With version 1.3, HDMI now also supports very high bitrate lossless compressed streams such as Dolby TrueHD.


HDMI connection

HDMI vs Component

The debate over which one is better in the battle of HDMI vs Component is a long raging one. But how are HDMI and component videos different? Read on and you'll know more.

In the times when High Definition video is taking over, there is still a very keen discussion on which of the video cable is better, HDMI or component. Some root for the advantages of HDMI over component, while others do not find much difference between HDMI and component. Before moving to the component vs HDMI comparison, let us first take a look at what exactly are these two, individually.

HDMI

HDMI stands for High-Definition Multimedia Interface. Basically, it is a medium for transmitting uncompressed audio-video data in a digital format. HDMI supports up to 8 channels of digital video as well as audio signals simultaneously on a single cable. It transfers data in the form of a digital bit stream.

Component Video

Component refers to a type of video signal that has been fragmented into multiple components. It more commonly refers to a kind of analog video which is transmitted or stored in the form of three separate signal components. Component transmits video signals in analog form i.e. it delivers the signals in the form of varying voltages which correspond to the red, green, and blue constituents of the video.

HDMI vs Component Comparison

Sr.No.	HDMI	Component
1.	Both HDMI and Component videos are video cable standards, that have the capability to support similar video resolution standards, but the difference is the way in which the two types transmit video signals.	
2.	HDMI transmits audio/video signals in digital form, i.e. in the form of serial data stream of bits.	Component video delivers video signals in an analog format. This means that the signal is delivered in the form of varying voltages representing the red, green and blue components of the video.
3.	HDMI video has both video as well as audio signals transmitting capacity in only one cable. This gives HDMI a slight edge.	A single component cable can carry only one type of a signal at a time - video or audio. Therefore, one needs at least three component cables to transmit video signal along with synchronized audio.
4.	HDMI cable can support 1080p video resolution which is something that component lacks.	Component supports a maximum of 720p resolutions and 1080i.
5.	HDMI scores when it comes to audio quality as well. HDMIs Dolby TrueHD and DTS-HD master audio capabilities simply give it the ultimate edge.	Although, component audio is inherently inferior, combining it with an optical Toslink Cable might just as well give HDMI a run for its money.
6.	Both HDMI and component, are fundamentally similar as they transmit by breaking up video images using almost similar techniques. Also, both end up displaying the same information, but using completely different forms.	

So, you can clearly conclude that, HDMI take a contest but by a small margin. To be on the safer side, you must physically check the quality of each of them, so that your own eyes decide which looks best in your display screen. Before you come to any conclusion, make sure to verify the display settings for both the inputs (HDMI or Component Video) are exactly the same. They can have varying brightness, black levels, etc. and you may come to a wrong conclusion.

Many people argue that HDMI signal format is a 'truly digital' one - i.e. there is no loss of video signal data from source in HDMI signals. However, this is not possible, as video signals are always scaled and processed in before being displayed. So, it is not easy to say which one is better in the battle of HDMI vs component video formats.

Isn't Digital Just Better?

It is often supposed by writers on this subject that "digital is better." Digital signal transfer, it is assumed, is error-free, while analog signals are always subject to some amount of degradation and information loss. There is an element of truth to this argument, but it tends to fly in the face of real-world considerations. First, there is no reason why any perceptible degradation of an analog component video signal should occur even over rather substantial distances; the maximum runs in home theater installations do not present a challenge for analog cabling built to professional standards. Second, it is a flawed assumption to suppose that digital signal handling is always error-free. DVI and HDMI signals aren't subject to error correction; once information is lost, it's lost for good. That is not a consideration with well-made cable over short distances, but can easily become a factor at distance.

So What Does Determine Image Quality?

Video doesn't just translate directly from source material to displays, for a variety of reasons. Very few displays operate at the native resolutions of common source material, so when you're viewing material in 480p, 720p, or 1080i, there is, of necessity, some scaling going on. Meanwhile, the signals representing colors have to be accurately rendered, which is dependent on black level and "delta," the relationship between signal level and actual as-rendered color level. Original signal formats don't correspond well to display hardware; for example, DVD recordings have 480 lines, but non-square pixels. What all of this means is that there is signal processing to go on along the signal chain.

The argument often made for the DVI or HDMI signal formats is the "pure digital" argument--that by taking a digital recording, such as a DVD or a digital satellite signal, and rendering it straight into digital form as a DVI or HDMI signal, and then delivering that digital signal straight to the display, there is a sort of a perfect no-loss-and-no-alteration-of-information signal chain. If the display itself is a native digital display (e.g. an LCD or Plasma display), the argument goes, the signal never has to undergo digital-to-analog conversion and therefore is less altered along the way.

That might be true, were it not for the fact that digital signals are encoded in different ways and have to be converted, and that these signals have to be scaled and processed to be displayed. Consequently, there are always conversions going on, and these conversions aren't always easy going. "Digital to digital" conversion is no more a guarantee of signal quality than "digital to analog," and in practice may be substantially worse. Whether it's better or worse will depend upon the circuitry involved--and that is something which isn't usually practical to figure out. As a general rule, with consumer equipment, one simply doesn't know how signals are processed, and one doesn't know how that processing varies by input. Analog and digital inputs must either be scaled through separate circuits, or one must be converted to the other to use the same scaler. How is that done? In general, you won't find an answer to that anywhere in your instruction manual, and even if you did, it'd be hard to judge which is the better scaler without viewing the actual video output. It's fair to say, in general,

that even in very high-end consumer gear, the quality of circuits for signal processing and scaling is quite variable.

Additionally, it's not uncommon to find that the display characteristics of different inputs have been set up differently. Black level, for example, may vary considerably from the digital to the analog inputs, and depending on how sophisticated your setup options on your display are, that may not be an easy thing to recalibrate.

The Role of Cable and Connection Quality

Cable quality, in general, should not be a significant factor in the DVI/HDMI versus Component Video comparison, as long as the cables in question are of high quality. There are, however, ways in which cable quality issues can come into play.

Analog component video is an extremely robust signal type; we have had our customers run analog component, without any need for boosters, relays or other special equipment, up to 200 feet without any signal quality issues at all. However, at long lengths, cable quality can be a consideration--in particular, impedance needs to be strictly controlled to a tight tolerance (ideally, 75 +/- 1.5 ohms) to prevent problems with signal reflection which can cause ghosting or ringing.

DVI and HDMI, unfortunately, are not so robust. The problem here is the same as the virtue of analog component: tight control over impedance. When the professional video industry went to digital signals, it settled upon a standard--SDI, serial digital video--which was designed to be run in coaxial cables, where impedance can be controlled very tightly, and consequently, uncompressed, full-blown HD signals can be run hundreds of feet with no loss of information in SDI. For reasons known only to the designers of the DVI and HDMI standards, this very sound design principle was ignored; instead of coaxial cable, the DVI and HDMI signals are run balanced, through twisted-pair cable. The best twisted pair cables control impedance to about +/- 10%. When a digital signal is run through a cable, the edges of the bits (represented by sudden transitions in voltage) round off, and the rounding increases dramatically with distance. Meanwhile, poor control over impedance results in signal reflections--portions of the signal bounce off of the display end of the line, propagate back down the cable, and return, interfering with later information in the same bitstream. At some point, the data become unrecoverable, and with no error correction available, there's no way to restore the lost information.

DVI and HDMI connections, for this reason, are subject to the "digital cliff" phenomenon. Up to some length, a DVI or HDMI cable will perform just fine; the rounding and reflections will not compromise the ability of the display device to reconstruct the original bitstream, and no information will be lost. As we make the cable longer and longer, the difficulty of reconstructing the bitstream increases. At some point, unrecoverable bit errors start to occur; these are colloquially described in the home theater community as "sparklies," because the bit errors manifest themselves as pixel dropouts which make the image sparkle. If we make the cable just a bit longer, so much information is lost that the display becomes unable to reconstitute enough information to even render an image; the bitstream has fallen off the digital cliff, so called because of the abruptness of the failure. A cable design that works perfectly at 20 feet may get "sparkly" at 25, and stop working entirely at 30.

In practice, it's very hard to say when a DVI or HDMI signal will fail. We have found well-made DVI cables to be quite reliable up to 50 feet, but HDMI cable, with its smaller profile, is a bit more of a puzzle. Because the ability to reconstitute the bitstream varies depending on the quality of the circuitry in the source and display devices, it's not uncommon for a cable to work fine at 30, 40, or 50 feet on one source/display combination, and not work at all on another

Note on DVI to Component Converter

For those of you looking to connect your new HDMI component with your existing component TV, unfortunately due to HDCP, this will not work. See the Component to HDMI Cable article for details.

HDMI vs DVI are they Compatible?

In reviewing HDMI vs DVI, we noted a few differences. So the big question is are HDMI and DVI compatible? Since DVI is the predecessor to HDMI, HDMI and DVI are identical as far as video is concerned. Therefore, video backward compatibility exists. However, DVI will not support digital audio. For example, if you have an older DVI connection on your source and a HDMI connector on your display, a HDMI to DVI cable is all that is needed in order to view the video. A separate audio cable (TOSLINK or SPDIF) will be needed to carry the digital audio. See our HDMI to DVI Converter article for all the details.

A Warning about Cable Length

The HDMI specification does not define a maximum cable length. HDMI 1.3 defined two categories of cables: Category 1 (standard or HDTV) and Category 2 (high-speed or greater than HDTV) regardless, neither HDMI or DVI works well over distances greater than 15 feet. If you need a cable longer than 15 feet consider top of the line cables such as our Cheap (Price not quality) HDMI cables or Monster cables. Some companies also offer amplifiers, equalizers and repeaters that can help bridge longer distances.

Which One should I Use Today?

When considering HDMI vs DVI, if available, we recommend HDMI. This is not because it is any better than DVI, only because the industry will heavily push HDMI due to the HDCP Digital Rights Management technology. However you should not expect any difference when moving from DVI to HDMI, therefore if you have DVI already stick with it until the next standard comes around. Also note you may be interested in staying with your component connections. See our HDMI vs Component article.